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Detecting Coastline Changes use GIS geospatial techniques in Island Carey- Morib Coast, Selangor, Malaysia

Mengesan Perubahan Garis Pantai menggunakan aplikasi GIS di Pulau Carey- Pantai Morib, Selangor, Malaysia

Nor Lita Fadilah Rameli & Mokhtar Jaafar

ABSTRACT

Coastal area is one of the very dynamic landscapes where erosion and deposition processes always occur. Therefore, a study is been conducted to detect changes of coastline caused by both processes at Carey Island-Morib coast. Geospatial technology that involved the use of GIS and satellite imagery had been apply in this study. Data sources are topography map of 1974 and SPOT image of 2008. The results show that coastal erosion process was dominant in Carey Island, while deposition process was the case for Morib coast. The average value of eroded distance is higher than the average value of deposited distance, which is 170 and 157 m, respectively. Coastal erosion process in Carey Island could be relate to the movement of big ships along Malacca Strait and Port Klang that is capable of producing big waves and eroding energy. Meanwhile deposition process in Morib coast could be relate to the transfer of land sediment to the estuary and along the coast by low-energy wave. These findings should be support with fieldwork study that could verify the effectiveness of coastal geomorphologic agents and the impact of human activities on land in influencing the changes of coastline in Carey Island-Morib coasts.

Keywords: Coastline; dynamic landscape; Selangor; Malaysia

ABSTRAK

Kawasan pesisiran pantai merupakan salah satu landskap yang sangat dinamik di mana proses hakisan dan pemendapan sentiasa berlaku. Oleh itu, satu kajian telah dijalankan untuk mengesan perubahan garis pantai yang disebabkan oleh kedua-dua proses di pantai Pulau Carey-Morib. Teknologi geospatial yang melibatkan penggunaan GIS dan satelit imej telah digunakan dalam kajian ini. Sumber data adalah peta topografi tahun 1974 dan imej SPOT 2008. Keputusan menunjukkan bahawa proses hakisan pantai adalah dominan di Pulau Carey, manakala proses pemendapan berlaku untuk pantai Morib. Nilai purata jarak terhakis adalah lebih tinggi daripada nilai purata jarak didepositkan iaitu 170 dan 157 m masing-masing. Proses hakisan pantai di Pulau Carey boleh dikaitkan dengan pergerakan kapal-kapal besar di sepanjang Selat Melaka dan Pelabuhan Klang yang mampu menghasilkan ombak besar dan tenaga menghakis. Sementara proses pemendapan di pantai Morib boleh dikaitkan dengan pemindahan sedimen tanah kepada muara dan di sepanjang pantai oleh gelombang tenaga rendah. Penemuan ini perlu disokong dengan kajian kerja lapangan yang boleh mengesahkan keberkesanan ejen geomorphologik pantai dan impak aktiviti manusia ke atas tanah dalam mempengaruhi perubahan garis pantai di pantai Pulau Carey-Morib.

Kata kunci: Pesisir; landskap dinamik; Selangor; Malaysia

INTRODUCTION

Generally, the coast is the area that separates the coastal land and sea areas. History has proven the coast into focus as diverse as the development of settlements, fisheries, agriculture, port activities, and recreation area (Zakaria 1970). However, changing times saw intensity variations and natural coastal ecosystems changes impressed on a beach due to development processes. Coastal resources unfortunately tapped without limitation, exposing the beach landscape to vulnerability. The increase in the intensity of coastal development utilizing the available resources in the coastal areas as well as the lack of awareness and involvement on conservation measures raises many negative impacts on the coastal environment. This coupled with the nature of the coastal ecosystems of the most dynamic landscape impact, effects of land and sea and wind actions. The combination of these three agents, and accompanied by human activities, can promote changes in the coastal zone. According to Faizal

(2005), changes in coastal or more accurately the changes in the coastline also strongly influenced by the effects of sea level rise from global climate change. Global climate change is believe able to change the process of sediment transport and transfer of land and sea next to a beach and has implications for the increase or reduction of precipitated material in coastal zones. The direct impact of this natural process is the change in shoreline position.

Malaysia, which has a length of 4,809 km coastline, not spared from natural processes in coastal zones. The two main processes geomorphology, namely, sediment erosion and deposition of material along the coastal zone, also change the size of a beach in the country (Ibrahim Kasawani 2010). Data from the Department of Irrigation and Drainage (DID) show nearly 1,400 km of coastline in Malaysia experiencing critical erosion process. The beaches of the east coast of Peninsular Malaysia are among the 65 listed with critical coastal erosion. Critical erosion (adopted by the DID) refers to any part of the coast that suffered erosion process that is difficult to contain, leaving a serious impact on the stability of the natural beach profile. In the socioeconomic context, it referred to a situation that is capable of threatening the lives of coastal residents, especially the aspects of safety and economy.

Although the beaches in Malaysia have long suffered serious erosion processes, the aspects of coastal management are not included in the priority list of the government until the 1980s. Before that, the responsibility for monitoring and implementing control works and mitigation coast was placed under the jurisdiction of the joint committee by the DID, district office and local government. As early as the 1980s, efforts were initiate to strengthen aspects of coastal management. The government has established a Coastal Engineering Technical Centre in January 1987, and this centre serves as technical advisor for any development projects involving coastal component. In addition, the agency is also responsible for performing the monitoring, control, and conservation of coastal zone with the primary focus is on coastal areas experiencing critical erosion problems.

As stated above, most beaches on the east coast of Peninsular Malaysia experience critical erosion process. However, the opposite detected in most of the west coast of Peninsular Malaysia. The beaches on the east coast of Peninsular Malaysia directly exposed to the weather phenomenon northeast monsoon aggressive large waves capable of eroding coastal zone. However, the opposite is happening in the western part of Peninsular Malaysia where wind and wave action are moderate and less aggressive and as corrosion agents rather than agent of deposition.

In this case, the beaches in Selangor are not immune from both the natural process of coastal erosion and deposition processes. As one of the most developed states in Malaysia, Selangor experienced a very rapid development process. Land use changes occur rapidly and also removed the sediments eroded into the river system that flows directly into the Straits of Malacca. Removed sediment eroded into the river system is transport to the mouth of the river, and most of the muddy sediments were deposit directly into the mouth of the river. Deposition process occurs because the waves are not aggressive beached exceed beached aggressive waves. This situation also assumed to occur at Carey Island-Morib coast. Preliminary observations in the field show that there are certain parts along the coast that suffered serious deposition process, while some others are experiencing erosion process. Accordingly, this article seeks to clarify the shoreline changes that may occur in the beach on the assumption that the changes of coastline Carey Island-Morib coast with regard to the presence of abundant precipitate at low tide and the waves much momentum until almost to the tires during high tide. Both pictures are observed during the initial observations convince the study about shoreline change at Carey Island-Morib coast to scientifically collect data that can be used as a foundation in to regulate and conserve resources in the coastal zone and this.

METHODOLOGY AND RESEARCH BACKGROUND

As stated above, the study of shoreline change is been done in Carey Island- Morib coast. The beach is located in the western part of Peninsular Malaysia 2° 50'53.41' N 101° 22'30.38' E and 2° 44'53.42' N 101° 26'35.65' E as shown in Figure 1. A long beach is about 30 km with muddy and sandy sediments. Carey Island coast drained by the Langat River skirting out into the Straits of Malacca in two directions, namely, to the north and south. The Straits of Malacca are one of the busiest sea routes in terms ship movement and carrier trade. The beach is knows for rest and recreation. There are clusters

of mangroves that exist between Carey Island and Morib coast, and the presence of mangrove is as a wave damper and buffer. Preliminary observations in the field show that there are certain parts of the mangrove clusters have collapsed and died, and this is an early indication of coastal erosion processes. Another part of the coast indicates the presence of many precipitates, and these precipitate are an early indication of deposition process.

To track the changes to the coastline of Carey Island- Morib coast, edge geospatial technology is fully applied. A summary of the study methodology shown in Fig. 2. In general, this article will only involve the measurement of shoreline change at the first stage of identifying the source of this change through map and source images. The second stage involves the measurement of the coastline in the field using the Global Positioning System (GPS), but this level will not been covered in this article.

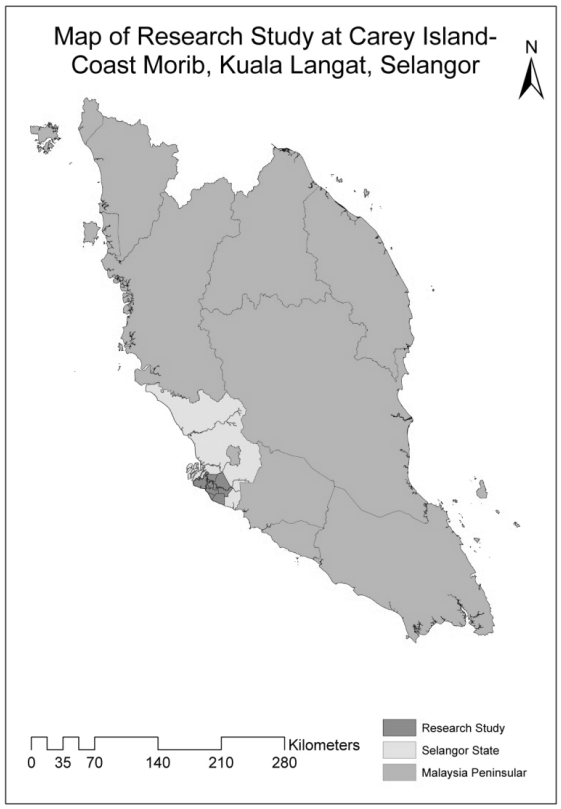

FIGURE 1. Carey Island- Morib coast

Source: Modified from Malaysia Peninsular Boundary map

The first process is digitizing the coastline of Morib coast and Carey Island (source topographic maps that represent the position of the shoreline in 1974). This process is been done using geographical information systems (GIS) in which a digital map layer built into ArcGIS package. The second process is SPOT satellite imaging which allows the position of the shoreline been viewed in 2008. ERDAS package is been used for this purpose. Both of these data sources through the same procedure as geometric, topological classification, and construction. Thematic maps are prepared from the two sources were analysed to detect the position of overlay coastlines of both the comparative and the measurement is done automatically by the system over 37 locations predetermined relative to the initial sampling (Fig. 3).

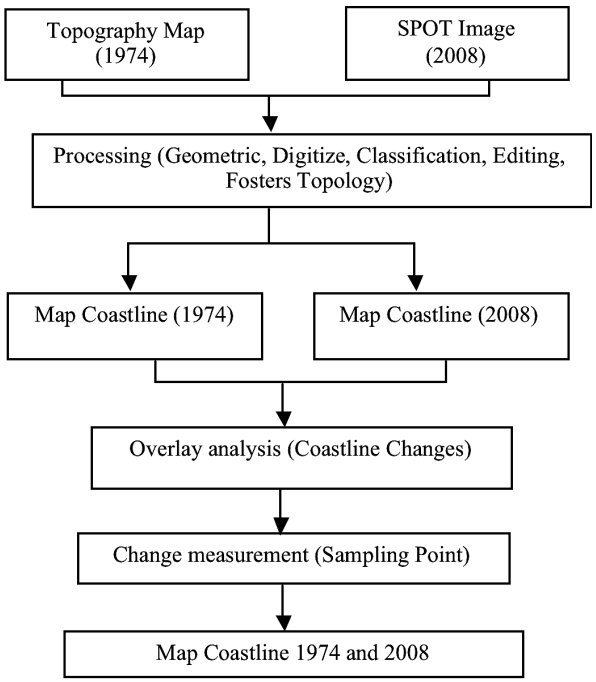

FIGURE 2. Flow chart of research methodology

RESEARCH RESULT AND DISCUSSION

Figure 4 shows the results of mapping Carey Island-Morib coast for 1974 and 2008. In general, both erosion and deposition processes can be traced along the coast. The north coast of Carey Island is diagnose with a serious erosion process, while the middle Morib beach suffered deposition process. Sg. Langat, south coast of Carey Island also found to undergo a process of erosion.

To clarify the picture of the erosion-deposition process that occurred on both beaches, shoreline change measurement data are shown in Table 1.

P1-P3 sampling locations that represent the area on the north coast of Carey Island recorded the average distance of highly eroded beach, about 261 m. Even the highest eroded beach distances are also record in this part of the sampling locations of P2 380.8 m. While the deposition process was clearly going seriously south of Morib coast. The average value of deposited beach distance recorded for P26-P30 sampling locations is 214 m. The distances recorded with highest coast deposits in the P27, P29 sampling locations respectively are 294.3, and 299.0-m.The average value of the eroded distance among the 20 sampling locations of Carey Island-Morib coast is 170 m, while the average distance with beach sediments is 157 m.

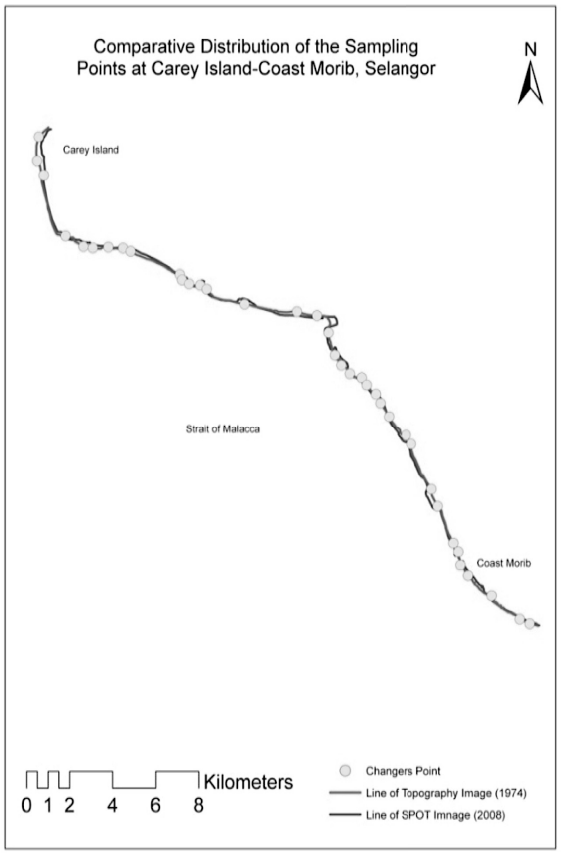

FIGURE 3. Distribution of sampling points relative

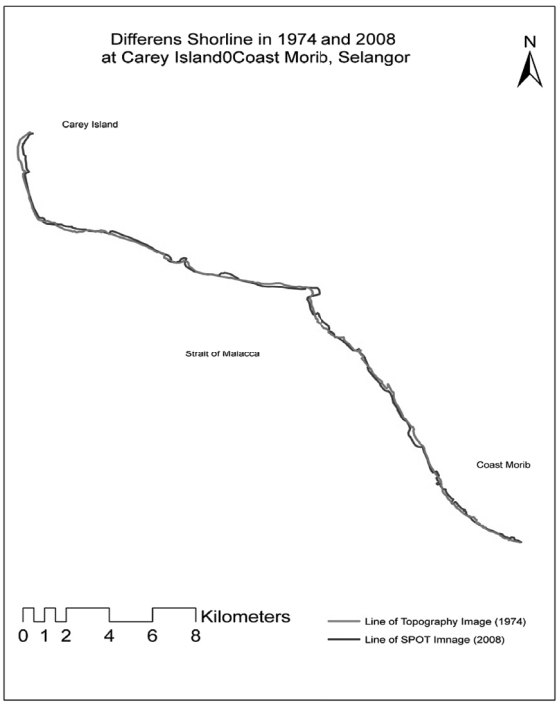

FIGURE 4. Comparison of shoreline in 1974 and 2008

Based on these initial findings, it is clear that Carey Island-Morib coast experienced more erosion process than deposition process. However, if the examination is given, the beach is actually more active Carey Island experienced the Morib beach erosion and deposition over the process. Generally, both processes are strongly influence by the action of the dynamic agents of fluctuation, which include coastal waves, currents, tides, and wind. All these agents act by affecting the energy intensity. The energy contained in the waves and currents is able to move the activity to alter the shape of the beach. Waves are the main cause of the changes taking place on the beach. Waves provide an important energy source for coastal construction, the production of materials at the basis of surface coastal sediments, and transporting the raw materials to the shore, offshore, and parallel to the beach (Muh Aris Marfai 2011). Damper waves on the beach cause waves of energy in particle-particle moving to loosen the knot next sand. If the wave energy decreases, the precipitated material deposited in the bottom and on the shore. Wave energy often reduced because there is friction with the water in front of him. However, additional energy can be derive when waves are back (Sharifah Mastura 1988). Therefore, it will affect the shape of Carey Island-Morib coast as waves act as natural agents.

TABLE 1. Distance Carey Island shoreline change-Morib

Sampling Location	Shore Distance (m) Erosion	Shore Distance (m) Deposition
P1	236	
P2	381	
P3	166	
P4		127
P5	179	
P6	127	
P7		65
P8		72
P9	140	
P10		53
P11	245	
P12		143
P13	140	
P14		157
P15	214	
P16		173
P17	130	
P18		200
P19	100	
P20	171	
P21	94	
P22		158
P23		94
P24	102	
P25	130	
P26		113
P27		294
P28		123
P29		299
P30		245
P31	150	
P32		218
P33	216	
P34	179	
P35		149
P36	137	
P37	171	

Currents in coastal area is create by the interference waves. This highly influential currents erode, transport and deposit sediment material. Currents also cause a rapid flow of water on the coast (Komar 1976). Wind action on the coastline occurs directly and indirectly. Currents and winds in both of these situations act as an agent of erosion or deposition. Wind indirectly creates waves and wave act as an agent of erosion and sedimentation in coastal areas. Slow waves tend to bring material from the beach last seabed sediments deposited in the study area. Velocity winds in the study area due to the position of the yield of the study area are located in the Straits of Malacca protected from strong winds as barred by the islands of Sumatra (Mohd Mustakim 2011).

Tidal processes are a regular and important phenomenon in the sea. The basis of this phenomenon is the high and low sea level (Zakaria et al. 1980). The period between high tide and ebb tide. Tides in the ocean is more influence by the moon than the sun. Time of high tide and low tide is closely relate to place the month. Tidal conditions determine the length of a beach profile. When the tides are changing coastline. During low tide, the beach profile is longer and at high tide, it is shorter.

In addition, human factors such as the movement of large ships in the Straits of Malacca are believed to play an important role in influencing the process of erosion on the north coast of Carey Island. This section is located close to Port Klang where many large ships move. Large vessels are capable of producing energy waves, and when the waves get to the beach, these act as an agent of erosion. While many of the beaches suffered deposition process at Morib, it is believe that land use activities on land have contributed presence of muddy sediments and stranded at the mouth of the river due to the slow wave energy. Slow waves are not able to transfer the precipitated material far from the beach; rather modest presence of coastal currents may have transferred most of the terrestrial sediment to other areas along the coast.

CONCLUSION

This article has discussed the shoreline change in Carey Island-Morib coast. Study rests on the assumption that both erosion and deposition processes impact the changes in shoreline position. Geospatial technology involves the use of GIS and satellite imagery applied in this study. Based on the analysis of thematic maps available, superposition of both experience both coastal erosion and deposition processes. However, coastal erosion processes were more dominant in Carey Island and more dominant deposition process in Morib coast. Apart from the action of natural agents, geomorphology, currents, tides and wind, it is believe that the movement of large ships in the Straits of Malacca and Port Klang has resulted in beach erosion processes in Carey Island. Human activities also contribute to the affect and the presence of lot of muddy sediment along the Morib coast. To confirm these initial findings, further studies need to be move to include observations in the field to measure the physical characteristics of the beach. The combination of data obtained from the analysis of thematic maps and field data is convincing more interpretation of shoreline change at Carey Island- Morib coast that can be associated with erosion and sedimentation processes.

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Nor Lita Fadilah Rameli
School of Social, Development and Environment
Faculty of Social Science and Humanities
Universiti Kebangsaan Malaysia
E-mail: etafadilah@gmail.com

Mokhtar Jaafar
School of Social, Development and Environment
Faculty of Social Science and Humanities
Universiti Kebangsaan Malaysia
E-mail: tar1011@yahoo.com

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